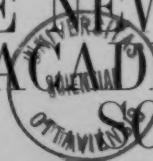


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## ON THE BEHAVIOR OF VOLCANOES

**T**HE UNEXPECTED ERUPTION of Tristan da Cunha, which had been regarded as extinct, points up the inadequacy of man's knowledge about volcanoes.

The origins and actions of volcanoes have been observed since earliest times, but, as pointed out in *Science* by Gordon A. Macdonald, volcanologist at the University of Hawaii, the major questions that puzzled ancient man remain unanswered today.

Among these are the origin of volcanic heat; how or where magma (molten rock) is formed; the mechanics of the rise of magma to the surface; and the subsurface structure of volcano systems.

Until very recently the study of volcanoes and all related things in the earth beneath was confined mainly to amassing data on the physical nature of lavas and the structure of volcanic mountains. Interpretation of these data to explain the processes within the earth that have produced the results seen on the surface is a relatively new activity. Macdonald attributes the delay in the interpretive phase of volcanology to the relative infrequency of volcanic eruptions (about 500 volcanoes have been active in recorded history), and the physical difficulties of studying them at close range.

As defined by Dr. Peter Stubbs in the *New Scientist*, an eruption is in essence the result of a mass of magma rising to the earth's surface and spilling over. Magma is generally believed to originate in the outer part of the earth's mantle, which extends approximately 2900

kilometers from the earth's crust to the boundary of the earth's core. The crust is from 20 to 60 kilometers thick on the continents, and as little as 3 kilometers beneath the seas.

Most of the world's volcanoes consist of lava flows composed of basalt. Since all estimates of the temperature in the outer part of the mantle are not close even to the surface melting point of basaltic lava, Macdonald believes a local rise in temperature may account for the formation of magma. He notes that "all over the earth volcanic areas commonly have thermal gradients considerably higher than the general average."

**J**ust how this heat becomes concentrated to produce volcanic activity is still undetermined. According to Dr. Stubbs, "large amounts of heat are somehow generated locally during orogenies," the geological processes of mountain making. "Shearing and intense friction during mountain formation could well be a contributory factor in heat generation," he believes.

On the broadly rounded, or shield, volcanoes, such as Mauna Loa and Kilauea, eruptions occur as the magma rises through cracks concentrated in areas known as rift zones, which extend radially from the apex of the mountain. These eruptions are known as "fissure eruptions," and are characterized by lava spurting from cracks that might be several feet to several miles long. There is very little explosive activity.

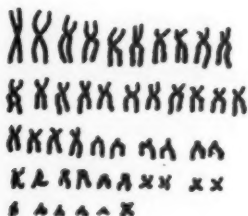
Tristan da Cunha belongs to the circular cone type of volcano in which the lava erupts from a central pipelike conduit. Explosive activity is more common in this type of volcano.

According to Dr. Stubbs, the "more acid lavas have a high viscosity." The greater the volume of gas, the lower the density of the magma and the easier it rises to the surface. The violence of an eruption, he believes, depends also in part on the "amount of energy that has been discharged." He cites the eruption of Krakatoa in the East Indies, where the vent was blocked and the pressure built up to such a point that the volcano literally blew off its top. Dormant 200 years, Krakatoa in 1833 blew away four cubic miles of itself.

All types of major volcanoes, according to Macdonald, are believed to be situated directly over chambers of indeterminate size and shape some four to seven kilometers below the general land surface. These act as storage basins in which the magma rising from the earth's outer mantle is held until eruption occurs. In support of

this view he cites the swelling and shrinking that may move a volcanic mountaintop up and down several feet before and during eruption.

But additional research is needed before accurate prediction of the time and type of eruption will be possible. One possibility of forewarning against unexpected occurrences, according to Dr. Stubbs, is the use of "highly sensitive seismographs that would have to be developed for the successful detection of nuclear test explosions."



## MONGOLISM

**I**N 1866, DR. LANDON DOWNS, physician and superintendent of a London mental institution, noted the facial resemblances of various groups of "imbeciles and idiots" to Ethiopians, Malaysians, American Indians — and Mongols. Of all his "ethnic classifications" only the term "mongolian" is used today. It identifies a segment of the mentally retarded population long considered by the medical profession as being beyond the reach of therapy.

Recently, however, it has been demonstrated that mongolism is amenable to medical management. Dr. Henry Turkel, reporting on twenty years of research in the field, describes a course of treatment with "U" series drugs (including more than 50 substances) he has found effective in "normalizing" the anatomical, physical and mental anomalies of the mongoloid.

While mental retardation is the major manifestation of this disorder, Dr. Turkel reasoned that mongolism represents, more accurately, a retardation of the "whole body"; almost every organ and tissue is involved. Therefore, his approach centered around a concept

of total therapy designed to secure the remission of the mongoloid stigmata.

He found that drugs which, when used singly, have proved ineffective in the treatment of the disorder, could be employed in combinations to produce favorable alteration of abnormal living tissue. The normalization is accompanied by improved function in all areas. As mental capacity improves, the patient becomes susceptible to training, learns to walk, sit, and establish toilet habits. Education in letter recognition and in writing follows. The correction of physical anomalies renders the patient esthetically acceptable and social interaction becomes possible.

After two and a half years of medical therapy, the gains are permanent and the patient needs only minimal maintenance. (Premature withdrawal of the drugs, however, is accompanied by regression.)

**T**his breakthrough in pharmacotherapy makes even more significant the advances on the diagnostic and etiologic research fronts. In 1959, Dr. Le Jeune and associates observed that an additional, short acrocentric chromosome, indistinguishable from group 21-22, is associated with mongolism. This 47-chromosome characteristic provides a useful diagnostic tool, particularly in the case of inconclusive evidence; that is, when upslanted eyes, flattened bridge of the nose, short and curved little fingers, simian palm, rudimentary ears, etc., are either not marked or attributable to premature birth or racial background.

Etiologic research, proceeding from the known fact that the incidence of mongol birth advances with the maternal age of the mother, currently includes investigations into the effects of genetical constitution. Significant endocrine imbalance in mothers of a group of mongol children has been reported by Drs. Coppen and Cowie, who earlier noted higher mean androgyny scores and mean biacromial diameters in mothers who, despite lower maternal age, gave birth to mongols.

In another avenue of research, some correlation between mongol birth and maternal exposure to abdominal radiation has been observed.

These additions to the scant body of knowledge on mongolism come at a time when improved standards of custodial care in institutions and effective control of many cardiovascular and respiratory

ailments have lengthened the life expectancy of the mongoloid to 32 years. If the nation's birth rate continues to rise, and the incidence of mongol to normal births remains constant, then the mongoloid population of the United States can be expected to outnumber all other classifications of the mentally retarded. Happily, there seems to be cause to hope that medical science will succeed in restoring some of these individuals to society. □ □

## MAN vs CLIMATE



**M**AN IS A RESOURCEFUL CREATURE who can adapt himself to almost any environment. But is he resourceful enough to adapt his environment to himself?

Tropic heat and Arctic cold have been conquered by air conditioning, proper clothing, insulation, irrigation and improvements in transportation. But, so far, the Sahara has not been made to bloom, or the Antarctic to warm up.

This has not prevented men from thinking of attempting the task. Damming of Bering Strait has been advocated to warm the Arctic by assuring circulation of warmer Atlantic water in the polar area, and a Gibraltar dam has been suggested to raise the Mediterranean's water level and facilitate irrigation of the entire Sahara.

Aside from considerations of practicality, these suggestions illustrate the immensity of the task of getting nature to do man's bidding. Climate control seems to be a "rather unequal struggle" to Helmut E. Landsberg, director of the office of climatology of the U. S. Weather Bureau. Discussing the tremendous disparity between terrestrial energy and solar energy, he notes in *Bulletin of the Atomic Scientists* that an average of  $2.8 \times 10^{18}$  calories arrives from the sun every minute.

This heat is set in motion within the atmosphere and at the earth's surface by reflection, scattering and absorption. On the surface, large wind systems are created. In the atmosphere, swift jet streams carry enormous air masses around the globe in an unending, turbulent stream. And within this system another complex system transforms water to vapor and back again, with an annual energy output of  $3 \times 10^{22}$  calories.

**W**hat can man pit against this? Landsberg asks. "Even nuclear energies now at our disposal dwindle into insignificance. A measly local thunderstorm transforms more energy than a half dozen 20-kiloton nuclear bomb explosions. And there are  $10^4$  thunderstorms per day on earth."

Man's role in climatic change is not an insubstantial one, according to H. Flohn, of the German Weather Service. In a paper on "Man's Activity as a Factor in Climatic Change" in *Annals of The New York Academy of Sciences* he notes that insofar as the effects of water balance, increase of carbon dioxide and artificial air pollution are concerned, "the occurrence of man-made effects on climatic changes, even on a fairly large scale, should not be underestimated. At least in tropical continents substantial changes in climate-producing factors are initiated involuntarily by man's activity, and we ought to visualize the danger that such effects are acting in an irreversible manner against his benefit."

The possibility of beneficial changes in climate on a smaller scale may include dissipating or deflecting incipient hurricanes by cloud seeding; feeding monsoons in West Africa with additional moisture to encourage precipitation over semiarid regions; reinforcing meteorological rhythm periods to achieve regular rainy and dry periods.

**M**an's unwitting interference has already caused changes of climate — although not for the better — on a local scale. Landsberg cites the change in composition of a city's atmosphere by the addition of noxious substances which have decreased solar radiation and increased fog. Rise in night temperatures and a slight increase in precipitation, as well as changes in the electric field and humidity, and reduction of wind speed are other developments.

In rural areas, notes Landsberg, changes can be achieved by windbreaks whose interference at the lowest layer of the atmosphere reduces low-level wind speed and, consequently, decreases snow

accumulation on lee slopes and evaporation of moisture from the soil. Deforestation can result in wide swings of temperature, increase in runoff and evaporation, lower humidity and higher wind speeds. Reforestation can cut temperature extremes, curb runoff, increase humidity and reduce windspeeds.

"Intelligent pooling of climatological knowledge with engineering practices will help to modify local climates," concludes Landsberg. "On a scale from a few square miles to  $10^3$  or even  $10^4$  square miles, climatic modifications are feasible."

But as for large-scale changes, he has his doubts. "Since the earth has about  $2 \times 10^8$  square miles of surface, all of them participating in the stupendous energy exchanges that take place in the atmosphere, there are no immediate prospects for interference on a large scale in climatic conditions." □ □



## THE RIDDLE OF SUNSPOTS

**F**OR CENTURIES, man has studied the great solar flares and pondered their significance. The inauguration of the space exploration program now opens a new path to a more lucid explanation.

Changes in the earth's geomagnetic field have been linked to solar phenomena. One explanation has been that solar-proton streams have been responsible for auroral displays and temporary geomagnetic disturbances. It is possible that solar streams of particles in their passage have transported geomagnetic fields; some investigators believe auroras and magnetic confusion may be caused by the interaction of solar streams with the geomagnetically trapped radiation of the Van Allen belts.

How this is done has not yet been satisfactorily clarified. "One



possibility is that since the parts of the Van Allen radiation belts mirroring in high altitudes are not stable, fluted groupings of Van Allen radiation will form, given a sufficient length of time," according to E. H. Vestine, of the planetary sciences department of The Rand Corporation.

"Within these groupings transient electric fields that are transverse to the lines of geomagnetic force within the atmosphere should grow exponentially with the time, tending to drive segments of geomagnetically trapped charged particles poleward," Vestine observed, at a meeting on solar variations, climatic change and related geophysical problems, sponsored jointly by The Academy and the American Meteorological Society.

Numerous investigators have sought to establish a relationship of sunspots to terrestrial phenomena, David Williams, of the Consolidated Edison Company of New York, points out. Thus, W. Herschel examined six periods between 1650 and 1800, and in 1801 advanced a concept that sunspots influence the economic cycle. Herschel concluded that in periods with little or no sunspots, "wheat was scarce and hence prices were high; conversely, in periods of abundant sunspots, crops were abundant and prices were low."

**T**his theory, which was later supported by W. Stanley Jevons, was not given much credence until 1934 when C. Garcia-Mata and F. I. Shaffner cited a "startlingly high degree of correlation between solar activity and total production, exclusive of agriculture, for the period from 1875 to 1930."

J. F. W. Herschel suggested the electromagnetic nature of sunspots in 1833, but it was not until 1908 that experimental proof of the existence of a magnetic field around a sunspot was obtained at Mt. Wilson, California.

Others have cited the relationship of sunspots to terrestrial magnetic disturbances which distort telegraphic communications. Guglielmo Marconi described interference with radio transmission during the appearance of sunspots in 1927.

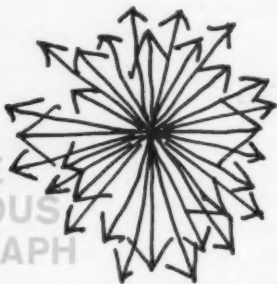
The far-reaching effects of sunspots have also been linked to interference with power stations. W. F. Davidson and L. W. Germaine have described the effect of the great magnetic storm of Easter Sunday, March 24, 1940. Ten power systems in the United States and Canada, as well as overseas radio-telephone circuits and major network broadcasting systems, were affected. In a sense the sunspots

appear to be able to exert a vast natural jamming of communications.

Williams suggests the possible mechanism involved in the effect on power systems. "Changes in the earth's magnetisms, probably caused by the ejection of charged particles from the disturbed portion of the sun, cause differences in earth potentials," he says. "Differences of earth potential at widely separated points where wye-connected transformers in the transmission system have their neutrals grounded, cause direct currents to flow in such a manner as partially to saturate the transformer cores. The excitation requirements of the transformers are thereby increased and the system voltage drops in an erratic pattern."

The sunspot riddle is closer to being solved than at any other time in man's history. Already, solar probes have revealed new data; for example, the preliminary findings of the Pioneer V solar probe "have shown that magnetic fields appeared in space millions of miles from earth." During the International Quiet Sun Year (1964), scientists will study the sun at a period of minimal solar activity. From their work may come solutions of old questions and the beginning of new puzzles. □ □

## THE UBIQUITOUS STAPH



**G**IVEN ENOUGH TIME, and a mutation or two, some bacteria will develop hardy strains to cope with a once-potent chemotherapy. When confidence in the power of a successful agent is accompanied with a related lessening of aseptic vigilance, the result is a staphylococcus problem.

From the viewpoint of the genetecist, the tough strain is interesting. From the viewpoint of the epidemiologist, it is highly distressing and a source of constant worry.

The chief culprit in the frequent hospital epidemics has been the phage 80/81 or the golden staph (*S. aureus*). Nurseries are natural targets; the babies may be infected by airborne contamination in the nursery environment, or by staph-carrying personnel.

The records of Christchurch Hospital, New Zealand, underscore the gravity of the problem. Staph is the most common cause of septicemia; of 71 patients with staph in 1957-1958, 51 were infected with penicillin-resistant disease, and of the 51, 29 died.

**T**he public has been highly sensitive to the problem. The hospital cannot be entirely isolated from the community. Infected babies brought home from the hospital nurseries have carried staph diseases with them, and have infected the family.

For the patient and the prospective patient, it is hardly reassuring to learn that a percentage of physicians are infected. A test made by Drs. R. S. Benham, I. Havens and J. J. Landy at a medical convention revealed that 15 per cent of the general practitioners in attendance carried resistant staph, and 25 per cent, enteric bacteria.

Staph infection operates in an endless cycle. There is a primary carrier who infects the environment; the environment then produces its own colonies which in turn infect new carriers. In attempting to cope with the problem, hospital authorities have isolated hospital personnel who were found to be carriers. But administrators have found it essential to re-emphasize and retrain attendants in all aspects of hospital asepsis.

Staph control committees have been formed. Their program includes the isolation of patients with staph infections, and a persistent ritual of decontamination of wards and operating theatres. New scrub techniques for surgeons, special precautions in hospital laundry units, disposable plastic gloves, and elimination of dry sweeping and vacuuming have been among the measures adopted by many hospitals, along with a number of staphylocidal substances.

Meanwhile, another front against the staph danger has been an effort to develop an anti-penicillinase serum, a chemical inactivator of penicillinase, and a modified penicillin. But the staph can fall in step again; investigators have recovered strains resistant to modified penicillin. Until researchers can balk the growth of resistant staph, the aseptic method will have to serve. Encouragingly, this approach has succeeded in markedly reducing the infection rate in many hospitals.

## THE HYPOTHALAMUS AND SOCIAL STIMULI



**R**ECENT STUDIES IN THE FUNCTIONING of the hypothalamus reinforce the theory that social stimuli, such as affection and social approval, may inhibit pituitary-adrenal response to emotional stress.

The hypothalamus is the basal part of the diencephalon, or inter-brain, and is believed to contain mechanisms for the control of fear, anger and anxiety.

In experiments, stimulation of the posterior hypothalamic zone elicited rise in blood pressure, dilation of the pupils and increase in the general excitability of the motor system. Effects of stimulation on the anterior and lateral hypothalamic zone were quite the opposite: blood pressure was lowered, the pupil constricted, and motor excitability reduced.

Writing in *Perspectives in Biology and Medicine*, Dr. Everett M. Bovard, of the Department of Anatomy, Albert Einstein College of Medicine, says research shows a "certain antagonism . . . between the autonomic and neuroendocrine functions of the anterior and posterior hypothalamic zones."

He cites experiments on cats which demonstrate reciprocal inhibition of the anterior and posterior hypothalamus zones: lesions of the anterior hypothalamus released posterior sympathetic function, while posterior hypothalamic lesions potentiated anterior parasympathetic function.

In other tests, electrical stimulation of the lateral parasympathetic zone in the rabbit inhibited neuro-secretion from the supraoptic and paraventricular nuclei which resulted from stress. Stimulation of the ventromedial nucleus in the sympathetic zone increased the secretion. In experiments on dogs, electrical stimulation of the anterior and dorsal posterior hypothalamic zones inhibited release of hydrocor-

tisone from the adrenal cortex, whereas stimulation of the ventral posterior hypothalamus increased the hormone release.

According to Dr. Bovard, these tests indicate that "two reciprocally inhibitory systems concerned with autonomic and endocrine function coexist in the brain, and that these are represented in, but cannot be too specifically localized within, the hypothalamus."

**I**t is believed the posterior zone of the hypothalamus mediates both the pituitary adrenal-cortical and the sympathetic adrenal-medullary components of the response to stress. In the pituitary-adrenal response, a humoral substance apparently is released from nerve fiber endings and carried through the hypothalamic-hypophysial portal vein system to the anterior pituitary where it precipitates release of adrenocorticotrophic hormone (ACTH) into the blood stream at a rate above the normal resting level of ACTH secretion. Activity of sympathetic areas in the posterior hypothalamus triggers, through the splanchnic nerve, the release of epinephrine and norepinephrine from the adrenal medulla.

As for the anterior zone, there is increasing evidence that it mediates release of somatotrophic or growth hormone (STH) from the anterior pituitary. STH has been shown to have protein anabolic effects at the cellular level, whereas hydrocortisone, an end product of the pituitary adrenal response, inhibits protein synthesis at the cellular level.

Experiments in which stimulation in the septal nucleus had the parasympathetic-type effect of slowing heart rate, led Dr. Bovard to the hypothesis that "electrical stimulation at locations and at stimulus parameters previously found to yield high self-stimulation rates will inhibit the plasma corticosterone response . . . to emotional stress. . . ."

Neurophysiologically, such stimuli as food, sex and water can be presumed, on the basis of available evidence, to activate anterior and lateral hypothalamic sites, he asserts.

On the human level, Dr. Bovard concludes, these findings indicate that "such reinforcing stimuli as affection and social approval not only have euphoric components . . . but also . . . the extremely important consequence of inhibiting the pituitary adrenal response to emotional stress. . . . If confirmed experimentally, it may go far to . . . account for the effect of the small group, as the family . . . in sustaining the individual under severe emotional stress. . . ." □ □

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